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ED 003 317 24

CURIOSITY AROUSAL AND ITS EFFECTS ON LEARNING.

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REPORT NUMBER CRP-1962 PUB DATE 64
EDRS PRICE MF-$0.18 HC-$2.60 65P.

DESCRIPTORS- *CURIOSITY, *LEARNING EXPERIENCE, *LEARNING PROCESSES, *LEARNING THEORIES, ELEMENTARY SCHOOL STUDENTS, GRADE 2, MEASUREMENT INSTRUMENTS, AGE DIFFERENCES, INTELLIGENCE DIFFERENCES, GRADE 6, DE KALB, ILLINOIS

AN ATTEMPT WAS MADE TO DEVELOP METHODS FOR OBSERVING AND MEASURING CURIOSITY IN CHILDREN. SPECIFICALLY, THE STUDY WAS DIRECTED TOWARD STIMULUS VARIABLES RELATED TO CURIOSITY AROUSAL, THE RELATIONSHIP OF AGE AND IQ TO INDEXES OF CURIOSITY, AND THE EFFECTS OF CURIOSITY ON LEARNING. SUBJECTS WERE APPROXIMATELY 30 CHILDREN FROM BOTH THE SECOND AND THE SIXTH GRADES OF PUBLIC SCHOOLS. THEY REPRESENTED A RANDOM SELECTION OF AVERAGE, ABOVE-AVERAGE, AND GIFTED IQ RANGES. ALL SUBJECTS WERE USED IN EACH OF THREE EXPERIMENTS. THE FIRST EXPERIMENT WAS DESIGNED TO OBTAIN OBSERVATIONAL DATA ON THE EXPLORATORY BEHAVIOR OF THE SUBJECTS, AND FOR USE IN DEVELOPING CURIOSITY MEASURES. IN THE SECOND EXPERIMENT, RESPONSE FREQUENCIES WERE RELATED TO VARIABLES IN STIMULUS MATERIALS. A THIRD EXPERIMENT WAS DESIGNED TO OBTAIN EVIDENCE ON THE RELATIONSHIP OF INCIDENTAL LEARNING TO THE EXPLORATORY BEHAVIOR OF THE SUBJECTS. RESULTS INDICATED THAT THE VARIOUS MEASURES OF EXPLORATORY BEHAVIOR USED IN THE STUDY WERE SAMPLING QUITE DIFFERENT ASPECTS OF BEHAVIOR, AND IT COULD NOT BE ASSUMED THAT ANY ONE SUCH MEASURE WAS AN ADEQUATE INDEX OF CURIOSITY. (JC)

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Cooperative Research Project No. 1962

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DeKalb, Illinois

1964

The research reported herein was supported by the Cooperative Research Program of the Office of Education, U. S. Department of Health, Education, and Welfare

ED003317

Acknowledgments

It is a pleasure to give recognition to those whose generous assistance made this study possible. First of all, the financial support and the provision of facilities, services and investigators' time were made possible by the U. S. Office of Education and Northern Illinois University. Second, two research assistants worked diligently on various phases of the study, Mr. Charles Faltz and Mr. Jonathan Hess. Both of them took more than a casual interest in their work and contributed significantly to the study. Finally, the children who served as subjects came from the following six elementary schools in DeKalb County, Illinois:

Haish School, DeKalb; Mr. Willard Widerberg, Principal

West School, Sycamore; Mr. Burdette Peterson, Principal

Kirkland School, Kirkland; Mr. Harold Flanigan, Superintendent

Waterman School, Waterman; Mr. W. Kent Robinson, Superintendent

Woodbury School, Sandwich; Mrs. Elsie Rex, Principal

Lynn Haskin School, Sandwich; Mr. Herman Dummer, Principal

The cooperation of the superintendents, principals and teachers involved was truly excellent. Those named above were the primary liaison persons and were helpful in many little ways which not only made the study possible but also made it enjoyable. Without the cooperation of such understanding people, much of our research on children would be seriously impaired.

Table of Contents

	page
Acknowledgements	ii
List of Tables	iv
Statement of the Problem	1
Procedure	6
Apparatus	6
Experimental design	6
Stimulus materials	8
Subjects	12
Data collected	13
Analysis of data	14
Analysis of the Data and Findings	17
Exploratory time and intensity ratings	17
Tachistoscopic exposure frequencies	20
Immediate and delayed recall	23
Factor analyses	24
Discussion	28
Conclusions	33
References	34
Appendix A	37
Appendix B	51

List of Tables

Table		Page
1	Procedural Days and Methods Used	8
2	Slides on Complexity and Abstractness	9
3	Slides for Incongruity and Ambiguity	11
4	Analysis of Variance of Exploratory Time (Day 1)	17
5	Analysis of Variance of Intensity Ratings (Day 1)	18
6	Analysis of Variance of Exploratory Time (Day 2)	19
7	Analysis of Variance of Intensity Ratings (Day 2)	19
8	Analysis of Variance of Exposure Frequencies for Complexity and Abstractness	20
9	Analysis of Variance of Exposure Frequencies for Ambiguity and Incongruity	21
10	Significant Results from Observational and Tachistoscopic Data (Experiments I and II)	22
11	Mean Number of Novel and Not-novel Objects Recalled	23
12	Factor Loadings Obtained by a 10-factor Solution	24
13	Code Numbers for Scores Used in Factor Analysis	54
14	Correlation Matrix	56
15	Factor Matrix for 20 Factor Solution	58

Curiosity Arousal and Its Effects on Learning

Statement of the Problem

Problem. The matters of developing and utilizing motivation for learning have long confronted those responsible for the education of children. In addition to relying on some general desire of children to learn, considerable use has been made of various incentive and reward methods, including desire for adult approval, competition among peers and verbal, social and material rewards, all of which are largely external and incidental to the learning itself. At the same time, little effort has been devoted to the scientific investigation of curiosity, the possible reward value inherent in satisfying curiosity and the effects of curiosity or exploratory behavior on learning. Although it is commonly assumed that young children exhibit considerable curiosity, we are almost totally ignorant of the factors which arouse and sustain it and, likewise, of the circumstances under which it is inhibited, dissipated or destroyed. It seems highly probable that an understanding of the nature of curiosity in children and its influence on learning would have considerable significance for education.

More specifically, this study focused on two methods of studying curiosity in two age and three ability groups of elementary school children and the effects of exploratory behavior on incidental learning. The methods were those of (1) observing behavior in a semi-structured situation and (2) using tachistoscopic exposure frequencies (a response measure) as an index of curiosity with materials representing various stimulus properties.

Objectives. The major objectives of this research were (1) to develop methods of observing and measuring curiosity in children, (2) to investigate stimulus variables related to curiosity arousal, (3) to investigate the relationships of age and Binet IQ to indicies of curiosity, and (4) to study the effects of curiosity on incidental learning.

Related Research and Theory. Much of the earlier work which is relevant to exploratory behavior and curiosity was done with animals. From his review of research involving spontaneous alternation, exploratory situations and reactivity tests, Glanzer (1958) concluded that there is clear evidence that (1) the animal behaves so as to maximize contacts with new parts of the environment and (2) that its responsiveness decreases systematically with continued exposure to the situation but recovers when the animal is absent from the environment. He also mentioned that in some learning situations animals have been found to learn in order to obtain access to new stimuli or exploratory situations. In general such evidence suggests that an organism is motivated to increase its exposure to the various parts of its environment.

Since Glanzer's review many additional animal studies in this area of investigation have been reported. The recent studies by Spear, Hill and Dennis (1963) and Hayes and Warren (1963) suggest that spontaneous alternation may not be as general a phenomenon as was indicated by the earlier studies. The investigation of more specific stimulus properties illustrated by Cooper's study (1963) of operant behavior in relation to stimulus complexity. Physiological studies such as those by Baettig (1963) and Haywood and Hunt (1963) dealing with the effect of lesions on exploratory behavior and the effects of epinephrine on novelty preference and arousal, respectively, indicate another direction in current animal research related to this area.

More pertinent to the present study, however, are the increasing number of recent studies using human subjects. These will be reviewed in terms of those dealing with (1) visual orientation, (2) stimulus variation, (3) stimulus novelty, and (4) stimulus complexity.

Visual orientation. Several studies have been reported dealing with the visual orientation of infants in response to various stimuli. Berlyne (1958a), using infants aged three to nine months, presented geometrically patterned stimuli in pairs and observed first fixations. He found that the patterns fixated first contained considerably more contour ("complexity") than those with which they were paired but found no differences as a consequence of stimulus intensity (white versus gray or black rectangles). In another study with adult subjects, Berlyne (1958b) found that fixation time was significantly greater for "more complex" figures but found no difference in initial fixations between simultaneously presented stimuli which varied in complexity. Kessen and Hershenson (1963) developed an elaborate appartus for photographing the corneal reflexes of new-born infants in which stimuli were presented that varied in brightness, complexity and organization. With infants tested on the third or fourth day after birth they found more frequent fixations for medium intensity than a bright one and more fixations for the bright than for a dim stimulus. Also, fixation preference was found for the most complex over the least complex of three stimulus patterns (black and white checkerboards of differing grain) but no differences were found for "organization," as depicted by three states of "facial disorder."

In another study with infants, Lewis, Meyers, Kagan and Grossberg (1963) investigated attention to to visual patterns as measured by visual fixation time, body movements (including vocalizations) and cardiac rate. Their subjects were 32 infants who were 24 weeks of age. The stimuli were pictures of faces and geometric designs, and patterns of blinking lights which were projected on a milk glass screen from strip film for 12 second intervals. Fixation times indicated rapid habituation with successive exposures but longer fixations for girls than for boys. Also, fixation times were longer for human faces than for geometric designs and longer for complex light patterns than for a single light pattern. Habituation was found to be an inverse function of the complexity of light patterns. There was a tendency for cardiac deceleration and decreased motor activity to occur when the infant fixated on a visual array.

Finally, White and Castle (1963) studied the effects of handling on the visual exploratory behavior of infants 37 days of age. Ten infants who ordinarily would have been reared under conditions of limited contact with adults were given small amounts of extra handling during their first five weeks of life. Subsequently, they showed significantly more visual interest as determined from continuous three-hour observation records than 18 non-handled infants.

Stimulus variation. A few studies have dealt with the stimulus variation preferences of human subjects. Friedlander (1962) reported more rapid satiation for a "neutral" stimulus (fuzzy circle of white light) than for "cartoon slides" used with four and five year old children. Further, extinction of a repetitious sequence was more rapid for the five year olds who also showed greater resistance to extinction under fixed and variable ratio visual reinforcement than did the four year olds. In a later study Friedlander and Dixon (1963) again found evidence of preferences for varied and non-repetitive visual and auditory stimuli among four and five year olds but no difference between "high redundancy patterned feedback" and "low redundancy unpredictable random feedback." The authors interpreted the latter finding as suggesting that factors other than perceptual conflict, uncertainty or representational value may mediate children's sustained attentional behavior.

Performance on a stimulus variation seeking scale was related to measures of originality derived from the Unusual Uses Test in a study by Penney (1963). Significant positive correlations were found for sixth grade pupils and college students but not for fourth graders. IQ was found to be unrelated to the stimulus variation seeking scale.

Stimulus novelty. Stimulus novelty has been the subject of investigation in three recent studies with children (Smock & Holt, 1962; Mendel, 1963; Cantor & Cantor, 1964). Smock and Holt attempted to induce perceptual conflict ("novelty") through use of ambiguous, incongruous and randomly organized materials with first grade children. While one may question whether novelty or some other variable was actually represented by the materials, the authors did find more frequent responses to stimuli described as having the above characteristics than to those not so characterized. In contrast with the Smock and Holt study, Mendal (1963) manupulated novelty by providing an habituation period for stimuli (toys) which were then regarded as not novel. Stimulus conditions were varied by the ratio of habituated to novel toys included in each array to which 60 children ages 3-6 to 5-7 responded. Preferences for toy arrays were found to increase as a direct function of their degree of novelty, the older children and boys in the sample preferring higher degrees of novelty to lower ones. No such preferences were found for younger children and girls in the sample. Cantor and Cantor (1964) also manipulated novelty with a familiarization period using some of the drawings from the Welsh Figure Preference Test. These were paired with drawings to which the subjects had not been exposed and were presented with a subject-controlled projector. They found that their kindergarten-aged subjects observed the

"novel" stimuli longer and that observing times deceased over trials for the familiar but not for the novel stimuli. No effect was found as a result of delaying the test series two days after the familiarization.

Stimulus complexity. The final group of studies are those dealing with the effects of stimulus complexity on exploratory behavior. Berlyne's study (1958b) on visual orienting responses utilized six variables regarded as forms of complexity (irregularity of arrangement, amount of material, heterogeniety of elements, irregularity of shape, incongruity and incongruous juxtaposition) with college age subjects. In each case more time was spent looking at the "more complex" figure of the 22 pairs of stimulus figures presented. Later Spitz and Hoats (1961) used the same stimulus pairs plus eight additional ones of similar nature with 30 retardates (mean CA 15.4 years), 30 "equal MA" normals and 30 "equal CA" normals. Following a three second exposure of each pair, the subject was allowed to re-expose one member of each pair for as long as 30 seconds. Contrary to Berlyne's findings, the total group re-exposed the complex stimuli less frequently than the simple figures but the "equal CA" subjects viewed the complex stimuli, when chosen, for longer periods. This difference was not found for the retarded and "equal MA" groups.

In a study with 22 pre-school children (mean CA 4-3), May (1963) provided an adaptation period with a deck of "medium complexity" cards having differently colored rectangles then permitted the subjects to select one card at a time for viewing from five decks of varied complexity (number of differently colored rectangles). First choices and total selections indicated a perference for the more complex stimuli. In an accompanying experiment, May found that his subjects chose to attempt making a more complex tinker toy object after having successfully completed an initial one of assumed medium level complexity.

Also using pre-school children (mean CA 4-10), Cantor, Cantor and Ditrichs (1963) presented Berlyne-type figures representing three levels of complexity to their subjects. The subjects were permitted to selectively view each stimulus of a triad, three stimuli being presented simultaneously in three separate boxes, for as long as he wished within a 60 second period. A significant effect was found for complexity but not stimulus triad or spatial arrangement. Three levels of stimulus complexity were also used by Pielstick and Woodruss (1964) who permitted two age groups of average ability and gifted children (CA means 8-4 and 11-11 and IQs 92-108 and 132 and above) to view drawings of common objects as frequently as they wished. Exposures were set at .20 seconds. Age and ability as well as complexity were found to produce significant effects on exposure frequencies in the direction of exposures of the more complex stimuli by younger and brighter children.

In summary, the results of these studies, though varied in stimuli, subjects and methodology, are quite consistent in suggesting the importance of stimulus variation, novelty and complexity in eliciting exploratory behavior. Unfortunately, clear distinctions are not always made among these stimulus properties so at the present time it is not possible to be definitive about the behavior arousal value of specific stimulus variables. Organismic variables, while little investigated, have yielded inconsistent results suggesting the need for further study. The present study was undertaken to check the validity of the findings in our previous study (Pielstick and Woodruff, 1964) regarding the age and ability variables, to test further the observational methods, to explore additional stimulus variables and to investigate the effect of exploratory behavior on incidental learning.

Procedure

Apparatus. A mobile laboratory (trailer) containing an experimental room nine feet by seven feet and an observation booth three feet by seven feet was used for experimental Days 1 and 2. An outside door opened into the experimental room. Built into the wall that separated the two rooms were a one-way window. In the experimental room was a table for stimulus objects, two chairs, a tachistoscope (encased except when in use), and a wall-screen.

Experimental design. Experiments I, II, and III were conducted in essentially a continuous and combined fashion. Each subject was seen for a specified period of time on three procedural days. Procedures for Day 1 and Day 2 were usually consecutive school days, though this was not critical. The procedure for Day 3 was always one week following Day 2. On Days 1 and 2 there were always two experimenters. One of the experimenters (E-1) brought the subject to the lab and gave appropriate instructions in the experimental room. The other experimenter (E-2) was never in contact with the subject but observed and recorded behavior behind the one-way window in the observation booth.

On Day 1, E-1 brought the subject to the lab from the school building and excused himself to "get some things we will be needing." He was gone for a period of seven minutes giving the child permission to "spend time with" the stimulus objects on the table and the mirror. During the seven minute observation period, E-2 recorded the amount of time, type of behavior, and degree of attention the subject gave to the stimulus objects. The extraneous behavior of the subject not related to the stimulus objects was also recorded.

After the seven minute observation period, E-1 came back into the lab with 24 tachistoscopic slides which were used in the first phase of Experiment II. The subject was allowed to operate the tachistoscope by pulling a string which caused a slide to be exposed for one fifth of a second. The subject was instructed to expose each slide as many times as he wished. (See Appendix A for picture of physical arrangement.)

On Day 2, E-1 again left the child alone in the experimental room with stimulus objects on the table. These stimulus objects differed from and were more numerous than those of Day 1 (20 rather than six). E-2 again recorded the subject's behavior in the fashion indicated above. After the seven minute observation period, E-1 returned to the lab and asked the subject to sort the 20 stimulus objects by selecting the ten which the subject thought were more novel or unusual. Then the objects were all put into a box and the box was placed in a storage cabinet. To obtain a measure of immediate recall, the subject was asked to recall as many of those

objects as he could and was allowed three minutes to do so. Following this the subject was allowed to expose another set of 24 slides which constituted the second phase of Experiment II. To bring about a partial counterbalancing of order, two random orders of the slides were presented. Each random order was given to half of the subjects. (See Appendix A for record forms.)

Day 3 was always one week after Day 2 and was usually conducted in a room provided by the participating school. The place was not as critical since no observation booth was necessary and only one experimenter was needed. First of all, the subject was given three minutes to recall as many of the 20 stimulus objects seen on Day 2 as possible. (See Appendix A for instructions and recording forms.) This was the delayed recall measure. Of critical interest for both immediate and delayed recall was the relative frequency with which the ten objects selected by the subject as most novel on Day 2 was remembered compared with the recall of the other 10 objects.

After the delayed recall test, Torrance's Ask-and-Guess Test of creative thinking was administered. A Mother Goose print of Tom, Tom the Piper's Son was projected on a screen with a conventional slide projector. The test consisted of three parts. In Part I, the subjects were told to ask as many questions as they could about the picture that could not be answered by looking at the picture. In Part II they were told to guess as many things as they could that might have caused or happened before the picture. In Part III they were told to guess as many things as they could that might be a consequence of or happen after the action seen in the picture. Five minutes were allowed for each part. In all cases the subjects were told to make as many guesses as they could and not to be afraid to guess. They also were told to use their imagination to think of new ideas, to think of as many ideas as they could that were unusual, interesting, and clever. The experimenter recorded the responses of the second graders. The sixth graders recorded their own responses. (See Appendix A for record form.) After the administration of the Ask-and-Guess Test, the work with a given subject was completed.

Across these three procedural days, Experiment I consisted of the two seven minute observation periods when the child was alone in the experimental room with the stimulus objects for Days 1 and 2. Experiment II consisted of the child's operant responses to the tachistoscopic slides on Days 1 and 2. Experiment III consisted of the immediate and delayed recall on Days 2 and 3. Also, on Day 3 the Ask-and-Guess Test was administered. The organization of these procedures is shown in Table 1.

Table 1

Procedural Days and Methods Used

Experiment	Day 1	Day 2	Day 3
I	7-min. observation (6 objects)	7 min. observation (20 objects) Novelty sort	
II	Tachistoscopic presentation of one set of 24 slides	Tachistoscopic presentation of second set of 24 slides.	
III		Immediate recall of objects explored and sorted above.*	Delayed recall of 20 objects

*This followed the observation period and preceded the presentation of the slides.

Stimulus materials. For Experiment I, Day 1, the six stimulus objects used were those employed in a previous study by Pielstick and Woodruff (1964). The objects were chosen to represent three classes of exploratory behavior, viz., those deriving from perceptual and epistemic curiosity and those resulting from a manipulation drive. The objects chosen to elicit perceptual attention were the mirror (one-way window) and novel object (specially made, no moving parts). Those for eliciting epistemic attention were a children's book written in Russian and a jig-saw puzzle, and those for eliciting manipulative behavior were a set of wire puzzles and a kaleidoscope. (See Appendix A.) Certainly these are neither purely isolated nor mutually exclusive categories, but the objects were selected as having greater arousal potential for one type of exploratory behavior than for either of the other two.

For Experiment I, Day 2, 20 objects were selected a priori in terms of novelty and manipulation. (See Appendix A.) Originally, four categories of five objects each were set up: novel-manipulable, not novel-manipulable, novel-not manipulable, and not novel-not manipulable. Pilot work

revealed that there was no valid way of determining in advance of the experiment what would be novel or manipulable to the subject. While children were able to select objects which were "novel or unusual," they seemed unable to sort objects on the basis of manipulability. Thcy could maneuver or manipulate any of the objects. Any objective property of manipulability intrinsic within the object itself, such as moving parts on objects, seemed to be meaningless. Hence, manipulability was abandoned as a variable. Novelty was retained but since what was novel for a particular child seemed to be a function of his unique, specific experiences, it was decided that each subject should sort out the ten objects most novel to him.

For Experiment II, Day 1, 24 tachistoscopic slides were constructed to represent two levels of complexity and two levels of abstractness. Table 2 shows the slides divided into six sets. The first two slides in each set are pictures of objects while the last two are pictures of abstract representations of objects. This gives two levels of abstractness with the dimension of complexity collapsed. In Table 2 it can also be seen that the odd numbered slides are simple relative to the even numbered slides giving two levels of complexity with the dimension of abstractness collapsed. Thus, within the 24 slides, there were 12 simple and 12 complex as well as 12 concrete and 12 abstract stimuli. Within each of the six sets of slides, one was simple and concrete, one complex and concrete, one simple and abstract and one complex and abstract.

Table 2

Slides on Complexity and Abstractness

Set A. Road intersection
1. Simple intersection
2. Complex intersection
3. Simple intersection on a roadmap
4. Complex intersection on a roadmap

Set B. House
1. Small house with uncomplicated exterior
2. Large house with complex window, wall, and roof lines
3. Simple blueprint of a house
4. Complex blueprint of a house

Set C. Electronics
1. Single FM tuner with two knobs and a dial
2. Control panel of a radio station
3. Simple mechanical drawing
4. Complex mechanical drawing

Table 2 (Con't)

Set D. Structures
1. I-Beams joined at the corner of a building under construction
2. Complex scaffolding and partially erected building
3. Simple geometric design
4. Complex geometric design

Set E. Mathematics
1. Simple arrangement of a few Cuisinaire rods
2. Complex arrangement of multiple Cuisinaire rods
3. Simple numerals, plus and minus signs
4. Complex formula with extensive symbolism

Set F. Music
1. Trombone
2. Saxophone
3. Simple musical score (two measures of half notes)
4. Complex musical score (a complex piano score with two cleffs of interrelated running notes.)

In Experiment II, Day 2, another set of 24 tachistoscopic slides was constructed. These slides represented two levels of ambiguity and two levels of incongruity. Table 3 snows the slides divided into six sets. These 12 slides had corresponding duplicates, precisely the same but out of focus. This provided two levels of ambiguity with the dimension of incongruity collapsed. Then, keeping in mind that, because of the out of focus duplicates, the Arabic numbers in Table 3 represent pairs of slides, the second pair in each set can be conceived of as incongruous relative to the first pair, giving the dimension of incongruity with the dimension of ambiguity collapsed. Again, there were 12 slides representing each level of each dimension and six sets, each representing the combinations of incongruity and ambiguity levels.

Table 3

Slides for Incongruity and Ambiguity

Set A. Writing
1. Hand in writing position with pencil
2. Hand in writing position with pliers

Set B. Pipe
1. Man holding pipe in mouth right side up
2. Man holding pipe in mount up side down

Set C. Refrigerator
1. Open refrigerator containing usual food objects
2. Open refrigerator containing a man's working boots

Set D. Mail
1. Hand dropping letter through mail slot
2. Hand dropping a slice of bread through mail slot

Set E. Telephone
1. Cradle telephone with receiver in place
2. Cradle telephone with hammer in place of receiver

Set F. Bathroom
1. Toilet fixtures in a bathroom
2. Toilet fixtures in a field of daisies

To determine if the material defined along dimensions of complexity, abstractness, ambiguity, and incongruity would be perceived this way by the children, pilot work was conducted with second grade children not participating in the study. This was done by administering four paired comparison tests, one for each of the dimensions represented in the slides. Two of these paired comparison tests were given to each of two second grade classrooms. There were 25 subjects for the comparison on the complexity dimension, 22 for incongruity, 25 for ambiguity, and 23 for abstractness.

In these paired comparisons, each of the 12 slides labeled as simple was paired with each of theslides labeled as complex. This made up 144 pairs which were administered to the children in random order. The children were asked to indicate

the slide they perceived as being most simple. The same type of paired comparisons were done for the dimensions of abstractness, ambiguity, and incongruity. In the case of abstractness, subjects were asked to indicate which picture was of a "real thing." In the case of ambiguity, they were to indicate the picture that was "more clear." In the case of incongruity, subjects were instructed to indicate the picture that was "silly or not as it should be."

For analysis of the paired comparisons, a response was counted as an "error" when the subject indicated the inappropriate slide to be simple, real, clear, or silly. On the complexity dimension, 16 of the 24 slides were "correctly" chosen with a frequency well beyond the .05 level of significance. Of the eight slides not reaching this frequency criterion, six were modified to increase the contrast between simple and complex. Of the two such slides that remained, one, the simple house, was retained because it barely missed the frequency criterion. The other, the saxophone, was retained because of the lack of a more complex appearing musical instrument. The slides modified or replaced in the stated fashion were the simple mechanical drawing, the simple road intersection, the simple blueprint, the complex Cuisinaire rods, and the complex musical score.

On the dimension of abstractness, the children perceived differences in the expected direction well beyond the .05 level of significance in all but one case, pairs including the simple Cuisonaire rods. This difference was so close to the stated level of significance that this slide was retained. On the dimensions of incongruity and ambiguity the differences were also perceived in the expected direction, well beyond the .05 level of significance.

Out of the complete paired comparison tests, the critical pairs within each set as listed under Tables 2 and 3 were compared. The differences here were again in the expected direction and were all significant well beyond the .001 level.

For Experiment III, immediate and delayed recall, the stimulus materials were the same 20 objects as were used in Experiment I, Day 2.

Finally, for the Ask-and-Guess Test on Day 3, a 35 mm colored slide was used as the stimulus. Tom, the Piper's Son, is running from a pig pen with a pig in his arms and is being pursued by the farmer holding a pitch fork. The slide was obtained from Torrance who used it in developing the Ask-and-Guess Test (1960, pp. 85-98).

Subjects. Sixty children drawn from the second and sixth grade classrooms of public schools in DeKalb County (Illinois) served as subjects. Thirty children were taken

from each grade level, constituting two groups with ages ranging from 7-5 to 8-7 for the second grade sample and from 11-5 to 12-4 for the sixth grade sample. Mean ages were 7-11 (95.0 months) and 11-10.7 (142.7 months), respectively.

Within each of the age groups there were three ability levels represented, viz., those within the Stanford-Binet (L-M) IQ ranges of 92-108, 112-128 and 132 and above. The mean IQ's of the second graders in these ability groups were 100.60, 117.70 and 140.10 and those for the sixth graders were 101.10, 118.40 and 142.90, respectively. Since in the earlier study by Pielstick and Woodruff (1964) it had been found that ability had some effect on the measures used for curiosity, it was decided to retain the average and gifted ranges and supplement them with a sample having scores falling midway between those ranges of ability.

Data collected. In Experiment I, the data were recorded by the experimenter (E-2) in the observation booth. There were two kinds of records kept concerning the child's behavior in relation to the objects. First, the amount of time, to the nearest second, that the subject spent with each object and in behavior extraneous to the objects was recorded. On Day 1 of this experiment, the behavior directed at each of the six stimulus objects was of critical interest. On Day 2, however, of critical interest was the differential amount of time directed at one of two categories of objects, novel or not-novel as sorted by the subject at the end of the observation period. The observer had no knowledge of these categories during the observation as the child had not yet made the sort. Thus, the manner of recording behavior on Day 1 and Day 2 was the same, i.e., time spent with each object and a description of behavior related to it. (See Appendix A for record forms.)

In addition to recording time and behavior descriptions, E-2 judged the intensity of curiosity exhibited toward each object with which the subject spent ten or more seconds consecutively. A 3-point rating scale was used, ranging from minimal to maximal degree of curiosity. Of major interest here was the mean intensity for each subject across all objects. Since only one rating was assigned for each period of time during which behavior was continuously directed toward a given object, the ratings were based on behavior for varied amounts of time. In order to determine whether the ratings should be weighted for time, both weighted and unweighted intensity scores were computed for a random sample of 18 of the 60 subjects. The unweighted scores were a simple mean of the intensity ratings and the weighted scores were determined by multiplying each intensity rating by the number of seconds of behavior which had been rated for intensity. A rank-order correlation computed between the unweighted and weighted scores yielded a coefficient of .97. Consequently, the simple mean intensity scores were used in the subsequent treatment of the data.

As a check on the reliability of the observation records, two observers were used for the first four subjects on Day 1. Day 1 entailed seven possible categories to which time could be assigned, viz., time spent with each of the six objects plus extraneous time. Thus, across the four subjects, there were 28 cumulative time scores for each observer. On 20 of the 28 scores, the discrepancy between observers did not exceed ten seconds. Also, when the cumulative time scores were summed for the four subjects and the objects ranked by these scores, there was complete agreement between observers on the rank order of the objects.

In Experiment II, the relevant data consisted of the number of times each subject exposed the slides falling into each of the categories listed under stimulus materials. (See Appendix A for record forms.)

The data for Experiment III consisted of those objects recalled immediately after the observation period on Day 2 and those recalled on Day 3, one week later. Separate scores were derived for the novel and not-novel objects in accordance with each subject's object sort.

Supplementary data on the subjects were obtained from the Ask-and Guess-Test which provided nine scores, viz., fluency, flexibility and adequacy scores for each of the three parts of the test. The protocols were scored by the Bureau of Educational Research at the University of Minnesota. On Part I of the Ask-and-Guess Test, the fluency score was the number of questions asked and on Parts II and III it was the number of guesses made about causes and consequences. The flexibility score was the number of different categories of such responses. The adequacy score was, for Part I, the number of questions asked that could not be answered just by looking at the picture. For Parts II and III it was the number of guessed causes and consequences that could conventionally be considered logical cause-effect relationships.

Analysis of data. Since the same subjects were used for all three experiments, the organismic variables of age (two groups) and ability (three groups) were the same for all experiments. A three-factor analysis of variance design for repeated measures (Lindquist, 1953, pp. 281-284) was employed for treatment of the data from Experiments I and II. For Experiment I, Day 1, one analysis used the exploratory time scores per object (six) as repeated measures. With age and ability this required a 2 x 3 x 6 design. A second analysis used the mean intensity scores per object as repeated measures and, again with age and ability, required a 2 x 3 x 6 design.

For Experiment I, Day 2, the repeated measures were the exploratory time scores for object category (novel and not-novel) for one analysis and the intensity scores for these

categories for a second analysis. With age and ability these analyses required 2 x 3 x 2 designs. Thus, for Experiment I (Days 1 and 2) there were four analyses of variance comparing the age and ability groups for the four types of repeated measure.

In Experiment II for both Days 1 and 2 the repeated measures were the exposure frequencies for each category of slides, viz., complex and non-complex, abstract and not-abstract, ambiguous and not-ambiguous, and incongruous and not-incongruous. Since each set of slides contained two variables simultaneously, a four-factor repeated measures design (Lindquist, 1953, pp. 292-297) was used. One such analysis was used for comparing the age and ability groups on the variables of complexity and abstractness (each with two levels). Another was used for comparing the groups on ambiguity and incongruity. Hence, a 2 x 3 x 2 x 2 design was employed for each of these two analyses.

The immediate and delayed recall data obtained in Experiment III were tested with t-tests to determine the effects of novelty on incidental learning. For each subject there were separate recall scores for novel and not-novel objects and the difference in recall of these two categories of objects was tested for both immediate and delayed conditions.

In addition to testing for specific effects, the data were factor analyzed using both iterated communalities and Verimax methods for five, 10 and 20 factor solutions. The variables included were as follows:

Exploratory times for six objects	6 scores
Judged intensities for six objects	6 scores
Exploratory times for novel and not-novel objects	2 scores
Judged intensities for novel and not-novel objects	2 scores
Exposure frequencies for complex, abstract, ambiguous and incongruous stimuli (2 each)	8 scores
Immediate recall, novel and not-novel	2 scores
Delayed recall, novel and not-novel	2 scores
Creativity scores (three for each of (three parts)	9 scores
	37 scores

Age and ability scores were not included since they were not continuous over the total sample and since their relationships with other experimental data had been tested by analysis of variance.

Analysis of the Data and Findings

Exploratory Time and Intensity Ratings. (Experiment I) Two behavioral measures were employed for the observation data derived from Days 1 and 2 of Experiment I, viz., (1) the time spent in visual and manipulative exploration of the objects (exploratory time) and (2) the intensity of such exploration as judged by the observer (intensity). The independent variables were age group, level of ability and object or object category. The results of the analysis of variance for exploratory time on Day 1, when six stimulus objects were used, are shown in Table 4. It is obvious that the objects

Table 4

Analysis of Variance of Exploratory Time (Day 1)

Source of variation	df	Mean square	F ratio
Between subjects	59		
Age (A)	1	170.83	.10
Ability (B)	2	210.68	.12
A x B	2	1,825.36	1.03
Error (b)	54	1,766.62	
Within subjects	300		
Objects (C)	5	298,680.33	43.66**
A x C	5	12,140.13	1.77
B x C	10	4,548.03	.66
A x B x C	10	6,568.91	.96
Error (w)	270	6,841.24	
Total	359		

**p < .001

account for variance in exploratory time as can be seen also in the following mean exploratory times for the six objects:

Object	Mean exploratory time (seconds)
Novel object	5.87
Mirror	12.78
Kaleidoscope	42.80
Wire puzzles	55.73
Jig-saw puzzle	196.17
Russian book	29.62

However, neither age nor ability had a significant effect on exploratory time and none of the interactions was significant.

The results for intensity ratings of the exploratory behavior exhibited towards these objects were similar (See Table 5) in that the variance due to objects was significant but

Table 5

Analysis of Variance of Intensity Ratings (Day 1)

Source of variation	df	Mean square	F ratio
Between subjects	59		
Age (A)	1	179.19	.01
Ability (B)	2	20,272.02	1.54
A x B	2	12,014.31	.91
Error (b)	54	13,131.69	
Within subjects	300		
Objects (C)	5	152,826.32	17.66***
A x C	5	42,739.92	4.94***
B x C	10	7,832.23	.90
A x B x C	10	6,409.87	.74
Error (w)	270	8,651.62	
Total	359		

***p $<$ .001

neither age nor ability had a significant effect on the results. However, there was a significant interaction between objects and age. Other interaction failed to reach significance.

Exploratory time and intensity measures were used also on the observation data obtained on Day 2. Although there were 20 stimulus objects, the time and intensity measures were based on the novel and not-novel object categories as sorted by each subject. Hence, the analyses were done using time and intensity scores for those two categories by age group and ability level. The results of the analysis of variance for exploratory time are shown in Table 6. Novelty (object category) did have a significant effect but the effects from age, ability and the interactions were not significant.

Table 6

Analysis of Variance of Exploratory Time (Day 2)

Source of variation	df	Mean square	F ratio
Between subjects	59		
Age (A)	1	7,664.00	1.62
Ability (B)	2	7,594.45	1.60
A x B	2	1,966.50	.42
Error (b)	54	4,736.56	
Within subjects	60		
Novelty (C)	1	168,975.10	9.43**
A x C	1	23.40	.00
B x C	2	1,017.05	.06
A x B x C	2	26,245.35	1.46
Error (w)	54	17,917.98	
Total	119		

**p $<$ .01

The analysis of variance for intensity ratings (Table 7) also indicates that a significant variance is associated with novelty. Again there were no other main effects or significant interactions by age or ability. However, the triple interaction (novelty x age x ability) was significant at the .05 level.

Table 7

Analysis of Variance of Intensity Ratings (Day 2)

Source of variation	df	Mean square	F ratio
Between subjects	59		
Age (A)	1	6,409.30	1.23
Ability (B)	2	7,200.45	1.38
A x B	2	4,764.90	.91
Error (b)	54	5,221.58	
Within subjects	60		
Novelty (C)	1	14,279.00	5.53*
A x C	1	25.40	.01
B x C	2	420.15	.16
A x B x C	2	9,294.85	3.60*
Error (w)	54	2,583.87	
Total	119		

*p $<$ .05

Tachistoscopic Exposure Frequencies. (Experiment II) Two scores were obtained for each subject on each of the four stimulus variables (complexity, abstractness, incongruity and ambiguity). One score was the total number of tachistoscopic exposures for a subject on a set of slides representing a low level of the variable, e.g., complexity, and the other was the exposure frequency for a set of slides representing a higher level of the variable. Since complexity and abstractness were both represented in the same slides and incongruity and ambiguity in other slides, only two analyses of variance were required to test the effects of the four variables. Age and ability also were included as independent variables.

The results of the analysis of variance for complexity and abstractness by age and ability are shown in Table 8. The main effects of complexity and abstractness were found to be significant at the .05 level, suggesting that the more complex

Table 8

Analysis of Variance of Exposure Frequencies for Complexity and Abstractness

Source of variation	df	Mean square	F ratio
Between subjects	59		
Age (A)	1	6,531.26	1.61
Ability (B)	2	2,435.45	.60
A x B	2	4,597.02	1.14
Error (b)	54	4,041.12	
Within subjects	180		
Abstractness (C)	1	375.00	4.32*
Complexity (D)	1	1,632.80	5.16*
A x C	1	81.66	.94
B x C	2	130.84	1.51
A x D	1	6.03	.02
B x D	2	260.62	.82
C x D	1	30.82	.77
A x B x C	2	2.63	.03
A x B x D	2	557.72	1.76
A x C x D	1	88.82	2.23
B x C x D	2	23.82	.60
A x B x C x D	2	21.20	.53
Error (w)	162	147.69	
Error 1 (w)	54	86.83	
Error 2 (w)	54	316.42	
Error 3 (w)	54	39.81	
Total	239	1,116.95	

*$p < .05$

and abstract materials elicited greater curiosity as indicated by frequency of exposure. Neither age nor ability had a significant effect on exposure frequencies and there were no significant interactions.

The analysis of variance for the incongruity and ambiguity variables revealed a significant effect for incongruity but not for ambiguity. (Table 9). The materials with greater incongruity elicited more responses (tachistoscopic exposures) than the less incongruous material. Age was also found to contribute significantly to the total variance, the younger

Table 9

Analysis of Variance of Exposure Frequencies for Ambiguity and Incongruity

Source of variation	df	Mean square	F ratio
Between subjects	59		
Age (A)	1	10,746.81	4.40*
Ability (B)	2	1,488.78	.61
A x B	2	2,219.78	.91
Error (b)	54	2,445.01	
Within subjects	180		
Ambiguity (C)	1	4.82	.14
Incongruity (D)	1	212.82	6.67*
A x C	1	68.26	1.98
B x C	2	68.96	2.00
A x D	1	.07	.00
B x D	2	13.62	.43
C x D	1	134.99	3.82
A x B x C	2	43.76	1.27
A x B x D	2	24.28	.76
B x C x D	2	83.04	2.35
A x C x D	1	84.02	2.38
A x B x C x D	2	97.04	2.75
Error (w)	162	33.87	
Error 1 (w)	54	34.41	
Error 2 (2)	54	31.90	
Error 3 (w)	54	35.30	
Total	239	656.27	

*$p < .05$

subjects exposing the stimulus materials more frequently. Ability and the various interactions were found to have no significant effects.

A summary of the significant findings from the analyses of variance applied to the observational and tachistoscopic data is shown in Table 10.

Table 10

Significant Results from Observational and Tachistoscopic Data (Experiments I and II)

	Independent variable	Finding	P value
Observational data (Experiment I)	6 stimulus objects	Variation in exploratory time according to object	.001
		Variation in judged intensity of curiosity according to object	.001
		Age by object interaction for intensity	.001
	Novelty (20 objects)	More exploration of novel objects	.01
		Greater intensity of curiosity for novel objects	.05
		Age by ability by novelty interaction for intensity	.05
Tachistoscopic data (Experiment II)	Abstraction	More frequent exposures of abstract stimuli	.05
	Complexity	More frequent exposures of complex stimuli	.05
	Incongruity	More frequent exposures of incongruous stimuli	.05
	Age	More frequent exposures of incongruous and ambiguous stimuli by younger group	.05

Immediate and Delayed Recall. (Experiment III) The incidental learning data of Experiment III consisted of immediate and delayed recall of two categories of objects, viz., novel and not-novel as determined by each subject's sort of the objects. The data were analyzed separately for the two age groups as well as separately for type of recall using the t-test. Means and t-values are given in Table 11. Second grade subjects recalled significantly more novel objects according to both the immediate and delayed recall measured. However, for the sixth grade subjects the means for not-novel objects were greater than for novel objects but with neither immediate nor delayed recall was the difference significant. For all subjects a significant difference was found when the delayed recall measure was used, indicating greater recall of novel objects, but there was not a significant difference on the immediate recall measure.

Table 11

Mean Number of Novel and Not-novel Objects Recalled

Age Group	Type of recall	Object category	Mean objects recalled	t-value
2nd grade	Immediate	Novel	5.40	3.43**
		Not-novel	3.93	
	Delayed	Novel	3.90	5.97***
		Not-novel	2.23	
6th grade	Immediate	Novel	6.07	2.03
		Not-novel	6.70	
	Delayed	Novel	4.20	.33
		Not-novel	4.27	
All S'	Immediate	Novel	5.73	1.52
		Not-novel	5.32	
	Delayed	Novel	4.05	4.44***
		Not-novel	3.25	

** $p \leq .01$
*** $p \leq .001$

Factor Analyses. Finally, the 37 scores (listed in Appendix B) derived from the observational data (exploratory times and judged intensities), tachistoscopic exposures (frequencies for each stimulus category), recall of novel and not-novel objects (immediate and delayed) and from the Ask-and-Guess Test were factor analyzed. Factor analyses were done in which the solutions were restricted to five, 10 and 20 factors. The correlation matrix as well as the factor matrix for the 10 factor solution is presented in Appendix B. All variables with loadings in excess of .30 on these 10 factors are shown in Table 12.

Table 12

Factor Loadings Obtained by a 10-factor Solution*

Factor	Variable		Loading
	Code**	Description	
I		Tachistoscopic exposure frequency:	
	1	Low complexity, low abstractness	.96
	2	Low complexity, high abstractness	.94
	3	High complexity, low abstractness	.95
	4	High complexity, high abstractness	.96
	5	Low incongruity, low ambiguity	.96
	6	Low incongruity, high ambiguity	.97
	7	High incongruity, low ambiguity	.95
	8	High incongruity, high ambiguity	.98
II		Ask-and-Guess Test score:	
	25	Ask fluency	.95
	26	Ask flexibility	.92
	27	Ask adequacy	.94
	28	Guess fluency	.73
	29	Guess flexibility	.71
	31	Consequences fluency	.71
	32	Consequences flexibility	.64
	33	Consequences adequacy	.48
III		Day 1 observation data:	
	15	Novel object, intensity	.80
	9	Novel object, time	.77
	14	Book, time	.61
	20	Book, intensity	.51
	17	Kaleidoscope, intensity	.49
	11	Kaleidoscope, time	.40

* Factor loadings less than .30 have been excluded.
** Code numbers refer to variables in factor matrix in Appendix B.

Table 12 (con't)

Factor	Code	Variable Description	Loading
IV	22	Not-novel object time (Day 2)	-.80
	21	Novel object time (Day 2)	.78
	23	Novel object intensity (Day 2)	.39
	35	Immediate recall, not-novel objects	-.37
	36	Delayed recall, novel objects	.37
	17	Kaleidoscope, intensity	-.30
V	37	Delayed recall, not novel objects	.81
	16	Mirror intensity	.77
	10	Mirror time	.44
	36	Delayed recall, novel objects	.38
VI	13	Jig-saw puzzle time	-.87
	19	Jig-saw puzzle intensity	-.73
	10	Mirror time	.53
	11	Kaleidoscope time	.46
	16	Mirror intensity	.35
	14	Book time	.32
	30	Delayed recall, novel objects	-.30
VII	30	Guess adequacy	.80
	33	Consequences adequacy	.58
	35	Immediate recall, not novel objects	.44
	14	Book time	.42
	20	Book intensity	.37
	29	Guess fluency	.34
	17	Kaleidoscope intensity	.33
	11	Kaleidoscope time	.30
VIII	34	Immediate recall, novel objects	.75
	36	Delayed recall, novel objects	.47
	31	Consequences fluency	.40
	11	Kaleidoscope, time	.39
	17	Kaleidoscope, intensity	.36
	33	Consequences adequacy	.34
	32	Consequences flexibility	.32
	20	Book intensity	.32
IX	24	Not-novel intensity (Day 2	.84
	23	Novel intensity (Day 2)	.56
	35	Immediate recall, not-novel objects	-.44
	32	Consequences flexibility	-.40
	22	Not-novel time (Day 2)	.33
X	12	Wire puzzles time	.85
	18	Wire puzzles intensity	.84
	10	Mirror time	-.31
	28	Guess fluency	.31
	35	Immediate recall, not novel objects	.30

The first two factors appear consistently and prominently with high loadings regardless of the factor space restriction. Factor consists almost totally of the tachistoscopic measures, all of which had loadings in excess of .90. Factor II, while less clear, is composed predominantly of creativity measures (Ask-and-Guess Test scores), the loadings ranging from .48 to .95. Three objects from the Day 1 observation situation, the novel object, book and kaleidoscope, (both time and intensity measures) carry the heaviest loadings on Factor III. On Factor IV the loadings shift to the novel and not-novel time measures and the novel intensity measure from the Day 2 situation with some loading from the recall data, the delayed recall of novel objects having a positive loading and the immediate recall of not-novel objects a negative loading. The heaviest loading on Factor V is the delayed recall measure of not-novel objects (positive) with mirror intensity and time from Day 1 observations having second and third highest loadings, respectively. Delayed recall of novel objects also has a slight loading on this Factor. Factor VI, like Factor III, is almost totally composed of time and intensity measures from the Day 1 observation data but with different stimulus objects, jig-saw puzzle time and intensity having the highest loadings (negative). Adequacy scores on the creativity test have the highest loadings on Factor VII but are mixed with immediate recall of not-novel objects and with time and intensity measures for the book and kaleidoscope. Factor VIII also is loaded with recall measures but this time for recall of novel objects. Again, some of the creativity measures load on this factor along with time and intensity for the kaleidoscope and intensity for the book. Intensity measures for both novel and not-novel objects (Day 2 situation) have the major loadings on Factor IX along with negative loadings for recall of not-novel objects and the flexibility score on the consequences part of the Ask-and-Guess test. There is also a slight loading for not-novel exploratory time. Finally, Factor X is composed primarily of the time and intensity measures for the wire puzzle of the Day 1 situation. Mirror time has a slight negative loading and the Guess fluency score (Ask-and-Guess Test) and immediate recall of not-novel objects have slight positive loadings.

When factor space was restricted to five factors, the first two factors remained predominantly those for tachistoscopic exposures and creativity measures as described above for the 10 factor solution. Factor III is almost the same except that jig-saw puzzle time and intensity measures come in with negative loadings. Responses to the novel and not-novel objects (novelty having high loadings) makes up the most of Factor IV as before but wire puzzle time and intensity come in with positive loadings. Mirror time and intensity have the primary loadings on Factor V with not-novel time, intensity and recall measures having low loadings.

In the 20 factor solution, the first two factors came out almost the same as in the 10 and five factor solutions. However, beyond the first two factors the loadings on each factor became almost consonent with the variables involved. For example, Factor III had loadings in excess of .30 only on the novel object (Day 1) time and intensity measures and Factor IV had such loadings only on the time measures for novel (positive) and not-novel (negative) objects. Loadings in excess of .30 on the other factors were as follows: Factor V, mirror intensity; Factor VI, jig-saw intensity and time (negative), Factor VII, Guess adequacy and fluency (Ask-and-Guess Test), Factor VIII, delayed recall of novel objects (negative); Factor IX, intensity for not-novel objects; Factor X, wire puzzle time and intensity.

Discussion. Exploratory behavior in the semi-structured situations of Experiment I was found to be greatly influenced by the particular stimuli employed, at least as measured by exploratory time per object and judged intensity of curiosity. Clearly the most effective object for eliciting and maintaining exploratory behavior of the six objects in the Day 1 situation (see objects in Appendix A) was the 500-piece jig-saw puzzle. While we may only speculate as to the reasons, it seems likely that relative to the other objects the jig-saw puzzle was characterized by complexity, manipulability, ambibuity and stimulus variation. The behavior-eliciting value of these variables has been indicated by the findings of several investigators. Those studies reviewed earlier in this report dealing with visual orientation (Berlyne, 1958a; White and Castle, 1963; Kessen and Hershenson, 1963; Lewis, et al., 1963) and those dealing with complexity (Spitz and Hoats, 1961; May, 1963; Cantor, et al., 1963; Pielstick and Woodruff, 1964) have yielded quite consistent results indicating the effectiveness of complexity in arousing and/or sustaining visual exploratory behavior. Manipulability apparently has not been investigated as a stimulus variable but was a major factor in the studies with rhesus monkeys reported by Harlow and his associates (Harlow, Harlow and Meyer, 1950; Harlow and McClearn, 1954; Harlow, Blazek and McClearn, 1956; Mason, Harlow and Rueping, 1959) in which evidence was claimed for its self-sustaining power and its positive effect on acquisition of manipulation skills. Two studies suggest the arousal value of ambiguity. Berlyne (1962) reported that curiosity increased with "uncertainty" of verbal material in his group of high school subjects. Also, Smock and Holt (1962) found that their first grade subject exposed the "ambiguous" stimulus materials more frequently than those considered as non-ambiguous, although it appears that ambiguity was not independent of complexity in the stimuli used. Finally, stimulus variation as treated in the studies of Friedlander (1962), and Friedlander and Dixon (1963) and in Fiske and Maddi's compilation of evidence on variation seeking (1961, pp. 175-277) can be seen to be a pertinent variable in arousing and sustaining behavior. As a jig-saw puzzle is assembled, its stimulus properties change and may therefore sustain its behavior arousal value beyond that of an unchanging stimulus objects.

Probably the combination of the characteristics mentioned above rather than the effect of any one of them is responsible for the extent and intensity of the behavior elicited. Consider in contrast the two objects for which time and intensity measures were lowest, the novel object and mirror. While the novel object may have been unique in the experience of the subjects, it elicited exploratory behavior (visual examination and handling) which was very brief, usually from one to five seconds duration. Stimulus characteristics which might have sustained such exploration seemed lacking. Apparently there was nothing further to explore, nothing to manipulate and little, if any, ambiguity. The mirror, on the other hand, could hardly be considered novel or ambiguous but did permit exploration (perhaps manipulation) of the subject's own behavior, although seemingly of a limited

nature. Both of these objects, then, would seem to be low in complexity, to offer little manipulation, to be unambiguous and to lack stimulus variation--properties which have been shown to be important in sustaining exploratory behavior.

In the Day 2 observation situation with 20 objects only stimulus novelty was manipulated. The procedure differed from that used by Cantor and Cantor (1964) in that the subjects were required to sort the stimulus objects into novel and not-novel categories following a 7-minute exposure to all the objects rather than exposing some stimuli for "familiarization" and regarding those not exposed as novel. In the present experiment "novelty" was determined by the subjects while in the Cantor experiment "novelty" was determined by the experimenter. The latter procedure would seem justified where all the stimuli are novel, i.e., not previously experienced, at the outset of the experiment. This assumption could not be made for the stimulus objects used in the present experiment. However, in spite of differences in methodology and in age of subjects, the results were essentially the same, i.e., that a significant main effect was found for novelty in the direction of longer and more intense exploration of the novel stimuli. These findings are also in agreement with those of Mendel (1963) and Smock and Holt (1962) even though their methodologies differed even more from that of the present experiment.

The findings regarding the stimulus variables of complexity, abstractness and incongruity in Experiment II with tachistoscopically presented materials are also in essential agreement with those of previous investigators. Berlyne (1958b) used 10 second exposures of somewhat different stimuli with college students and found longer exploration times for "complex" figures, including irregularily of arrangement, greater amount of material, heterogeneous elements, irregular shapes and incongruous figures. The previous experiment by Pielstick and Woodruff (1964) using a set of stimulus materials similar to those in the present study (drawings rather than photographs of objects) yielded significant results in favor of more complex stimuli for a different sample of subjects in the same age ranges as the current study. Again, Cantor, Cantor and Ditrichs (1963) obtained similar results for complexity with a slightly different procedure and younger subjects. It was noted that during the paired comparison work and the experiment proper the incongruous stimuli we developed frequently elicited laughter from the youngsters. Such items as a slice of bread being inserted in a mailing slot and a hammer on the cradle of a desk phone were particularly effective in eliciting humor. No such reactions were noted to any of the other categories of stimuli. To our knowledge abstractness has not been manipulated previously as a stimulus variable in exploratory behavior but was found to be a significant factor in this experiment.

Ambiguity was the only one of the four stimulus variables in Experiment II which did not significantly affect exposure

frequencies. It is suspected that the quality of the slides and the order of presentation ratner than the irrelevance of the variable may have been responsible for negative results. Ambiguity was created by out-of-focus photographs of the same objects which were used as unambiguous stimuli. There was no calibration for the degree of out-of-focus althougn the paired-comparison data indicated clearly that youngsters of the age used in this sample could distinguish between the ambiguous and unambiguous stimuli. Those objects pnotographed out-of-focus resulted in a smaller image on the slide as a consequence of the lens setting on the camera. The second factor, order of presentation, was probably more critical. Each series of slides was presented in one of two random orders. As a consequence, some of the objects were presented to the subjects on an in-focus (nonambiguous) slide before its out-of-focus counterpart was shown. This, no doubt, greatly diminished the apparent ambiguity of the out-of-focus stimulus. Spontaneous remarks of the subjects indicated that at least some of them considered it the second presentation of the same object. Possibly the degree of ambiguity was not sufficiently achieved with these materials and/or the procedure employed.

Neither age nor ability was found to have a significant effect on the types of exploratory behavior discussed above whether measured by exploratory time or judged intensity during the 7-minute observation periods or by exposure frequencies of the tachistoscopically presented stimuli. These results are, for the most part, in agreement with the findings of our previous study (Pielstick and Woodruff, 1964) in which age and ability did not affect time and intensity measures of observed behavior. However, the younger and brighter subjects were found to expose the tachistoscopic slides more frequently although it was pointed out that the overlap between groups was considerable. While there are no other studies known to us in which ability has been used as an independent variable in relation to exploratory behavior, two studies have been reported in which the effects of age were determined. Friedlander (1962) found no difference between his four and five-year-old subjects in preference for stimulus variation. On the other hand, he did find two response differences which held for the five-year-olds but not for the four-year-old group, viz., (1) faster extinction with repetitious than with varied sequences and (2) greater resistance to extinction under fixed and variable ratio reinforcement than under continuous reinforcement. Mendel (1963) also reported a significant age trend in preferences for differing degress of novelty, the older subjects within the 3-6 to 5-7 age range choosing toy arrays with higher proportions of novel (unfamiliar) toys. It appears, then, that while age may have some effect, it is not a pervasive variable in exploratory behavior and its effects are not clearly delineated by current evidence.

That motivation for visual exploration and object manipulation is effective in bringing about learning in monkeys has been shown by Butler (1953), Harlow, et al. (1950) and Harlow and McClearn (1954). Berlyne (1954) reported some evidence

from his study with human subjects that "surprising statements" were more likely to be recalled than others but his measures of curiosity and recall were not clearly differentiated. The effect of novelty on immediate and delayed recall was found to be significant only for the younger age group (7-5 to 8-7) in the present study. Both exploratory time and judged intensity for the novel objects were found to be positively associated with recall of novel objects, suggesting that the greater behavior arousal value of the novel objects had some influence on learning. The results obtained so far indicate that further work on this problem would be fruitful but again it is obvious that considerably more investigation is needed.

Inspection of the correlation matrix and the factor loadings (Appendix B) reveals a high degree of independence among the types of measures used in this study. While all of the exposure frequency scores are highly interrelated, none of them correlates significantly with any of the other variables included in the factor analysis. It is particularly interesting to find a lack of relationship between the exposure frequencies and observed exploratory time. Apparently these two types of measures are reflecting quite different aspects of exploratory behavior. On the other hand, the coefficients between judged intensities and exposure frequencies were somewhat larger and yielded some consistent trends. For example, all of the coefficients between exposure frequency and kaleidoscope intensity were positive while all of those of exposure frequency with jig-saw puzzle and book intensities were negative. Perhaps the visual exploration of the tachistoscopically presented materials resembles more closely that of the kaleidoscopic designs than of the jig-saw puzzle and book.

The exploratory time and intensity scores, themselves, seem to be quite object-specific, the intercorrelations being very low except for significant negative relationships between jig-saw puzzle time and the time measures for the other objects. Since jig-saw puzzle times were quite long, often constituting a majority of the observation period, variation in these times would determine in part the amount of time remaining for exploration of the other objects. Intensity scores for the various objects would not be expected to be similarly influenced and, in fact, were not found to show a negative association between jig-saw puzzle scores and scores for the other objects.

That the time measures were positively associated with the intensity measures is clearly indicated by coefficients which ranged from .53 to .69 for the six objects. Considering the fact that some of the intensity judgments were based on behavioral segments of little longer than 10 seconds duration, the minimum period for which judgments were made, these correlations are about as high as could be expected.

Torrance's Ask-and-Guess Test was selected because it was suspected that of the various devices which have been used for measuring creative thinking this one would be

likely to be most closely associated with the measures of exploratory behavior used in this study. However, with the exception of the Guess-adequacy scores, none of the creativity scores correlated significantly with any of the other variables used in the factor analysis. The Guess-adequacy scores, i.e., the adequacy of guesses made about causes for the situation depicted in the stimulus slide (Tom, Tom, the Piper's Son), were found to be negatively associated with the eight tachistoscopic exposure frequencies. While one may speculate as to the reason for this finding, it would seem more fruitful to attempt to account for the lack of association between the other eight creativity scores and tne measures of exploratory behavior used in this study. The hypothesis tested in this study was that of a linear relationship between exploratory behavior and creativity scores. However, it seems possible that, in general, curiosity as manifested in exploratory behavior might be a necessary (or at least favorable) but not sufficient pre-condition for creative productivity. If such were the case, it would not necessarily result in a significant linear coeeficient.

Some comment seems warranted regarding the factors which were extracted in the factor analyses. Taking the 10-factor solution as a basis for discussion, the heavy and almost exclusive loadings of exposure frequencies on Factor I shows again the independence of the tachistoscopic behavior from the other behavioral measures. Both visual exploration of the projected stimuli and manipulation of the tachistoscope, itself, seem to be involved but may represent different manifestations of curiosity. Our present data do not permit us to clarify this matter. Nevertheless, it is possible to say that while some of the stimulus variables did affect exposure frequencies, there were high correlations among the exposure frequencies for different sets of stimuli.

Factor II is composed almost as heavily and exclusively of loadings from the nine creativity scores. Since the validity of the Ask-and-Guess Test is not well established, it is difficult to interpret this factor except to recognize its independence of the other measures included in the factor analysis. Factor III appears to be a visual exploratory, non-manipulative factor which differs in some respect from the exposure frequency type of visual exploration of Factor I. Factor IV looks like a high-novelty factor with high negative loadings for the not-novel object times of the Day 2 situation and high positive loadings for the novel time and intensity scores in this situation. In sharp contrast, Factor V has high positive loadings for recall of not-novel objects and for mirror intensity and time scores suggesting, perhaps, responsiveness to not-novel stimuli. The high negative loadings of jig-saw time and intensity on Factor VI along with positive loadings for mirror time and intensity and for kaleidoscope time may suggest another form of passivity or low manipulation.

Considering only the two highest loadings on each of the remaining factors, Factor VII appears to be an "adequacy" factor reflecting the ability to make relevant guesses about

causes and consequences of situations. Factor VIII seems to represent high novel recall while IX seems to be a matter of intensity of exploratory behavior whether in response to novel or not-novel objects. Finally, Factor X appears to be a high manipulation factor as elicited by the wire puzzles.

From these results it is apparent that the behavior represented in the various measures used in this study is highly complex. Even when studying exploratory behavior which is not goal-oriented, it is probably meaningless to speak of exploratory behavior as though it were unitary phenomenon.

Conclusions

The data obtained in this study pertaining to two age groups of children with CA's approximately 8 and 12 years and representing average, high and gifted levels of ability were derived from (a) two observational situations, (b) the tachistoscopic presentation of stimuli varying in complexity, abstractness, incongruity and ambiguity, (c) immediate and delayed recall of objects and (d) a test of creative thinking. The findings provide support for the following conclusions.

1. Specific objects vary greatly in their effectiveness in arousing and sustaining exploratory behavior. This is indicated by both cumulative exploratory time and judged intensity of curiosity. It is suggested that a combination of stimulus variables rather than any one stimulus property determine the behavior arousal value of an object.

2. Those objects which are considered by an individual to be unusual or novel elicit more exploratory behavior and behavior which is judged to be of greater intensity than do objects not considered to be novel.

3. Complexity, abstractness, and incongruity tend to increase visual exploratory behavior as revealed by subject-controlled tachistoscopic exposures. Ambiguity as represented in the stimulus materials used in this study had no effect on exposure frequencies.

4. Neither age nor ability had significant effects on the types of exploratory behavior measured in this study. It is possible that these variables would be significant determinants of curiosity with other types of stimulus material.

5. For some age groups the degree of novelty apparently has some effect on retention as measured by immediate and delayed recall. In this study the recall of eight year old children was facilitated by novelty while that of 12 year old children was not.

6. Finally, the factor analytic results indicate that the various measures of exploratory behavior used in this study were sampling quite different aspects of behavior and it cannot be assumed that any one of such measures is an adequate index of curiosity or general exploratory behavior.

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Appendix A

Photographs of Day 1 stimulus objects with subject and Day 2 stimulus objects without a subject.

Photograph of arrangement for tachistoscopic presentation of stimulus materials (slides) for Experiment II.

Behavior Record Sheet for Experiment I, Day 1.

Behavior Record Sheet for Experiment I, Day 2.

Instructions for novelty sort.

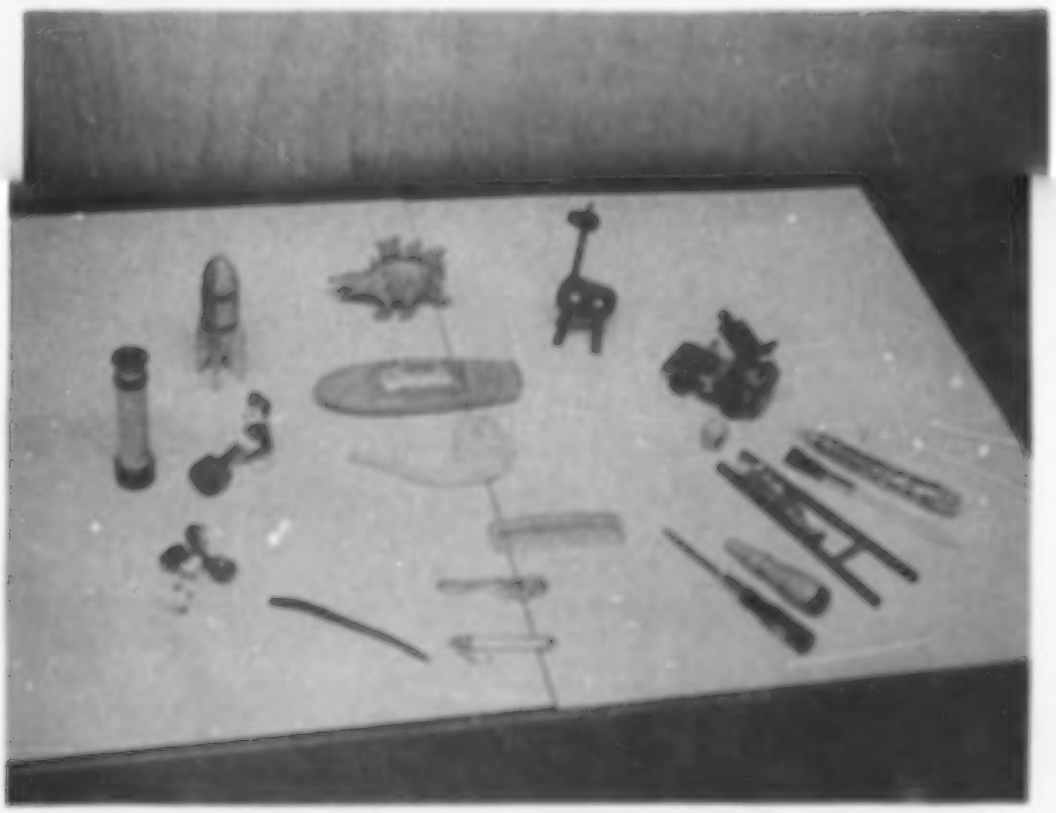
Record sheets for Experiment II (4).

Instructions for immediate recall, Experiment III.

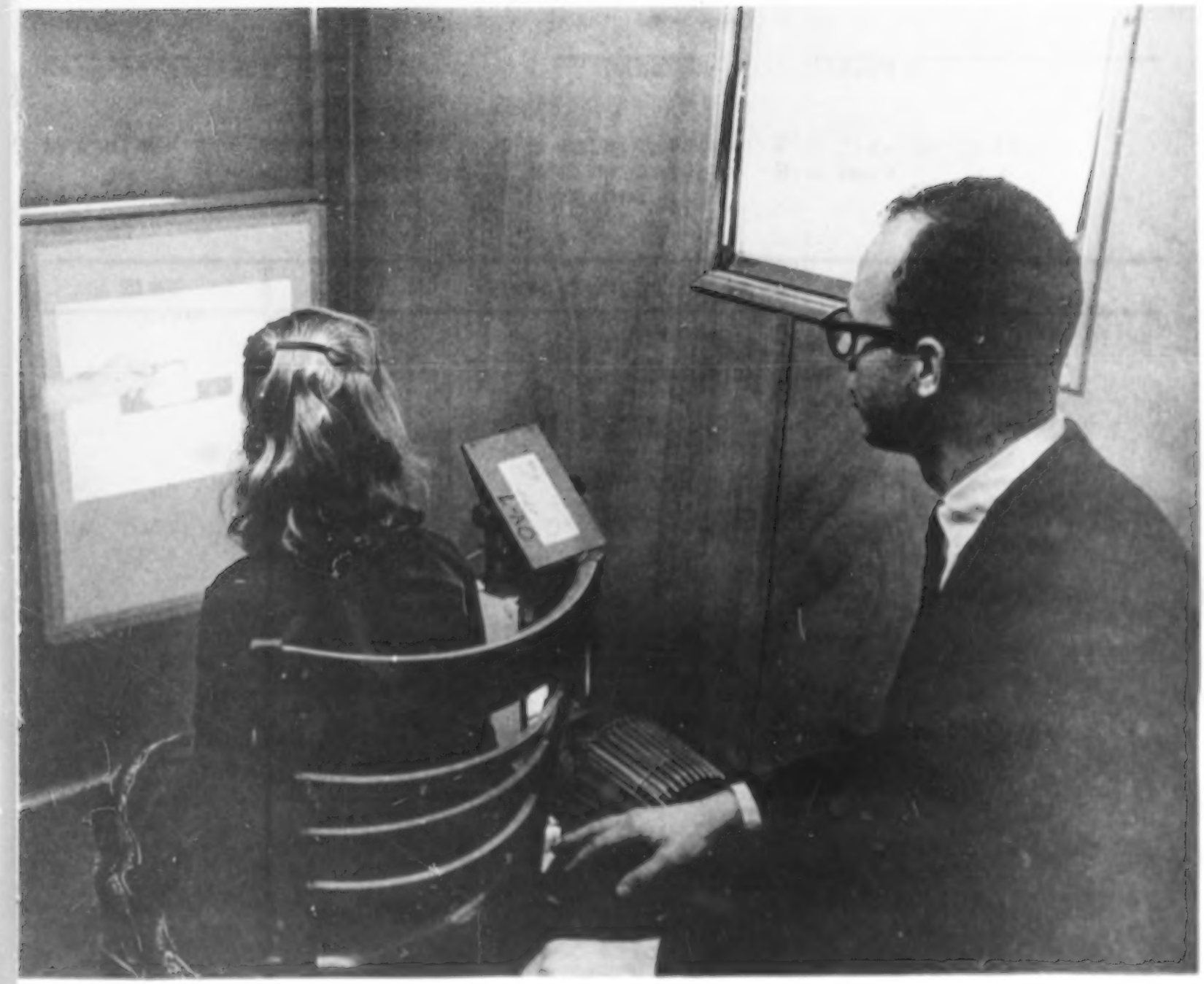
Instructions and record sheet for delayed recall, Experiment III.

Record booklet with instructions for Verbal Creative Thinking Tasks, Form VA, Ask-and-Guess Test.

Day I Stimulus Objects for Experiment I



Day 2 Stimulus Objects for Experiment II



Arrangement for Tachistoscopic Presentation of Stimulus Materials for Experiment II

Experiment I, Day 1

Behavior Record Sheet
Curiosity Study

Name of Subject _____ Date _____ Observer _____

Symbols: N = novel object K = kaleidoscope J = jig-saw puzzle
M = mirror(s) W = wire puzzles in box B = book

Time	Description of behavior

Experiment I, Day 2

Behavior Record Sheet

Date _____ Subject _____

20 objects, Day 2

Observer _____

Write a number in front of those chosen as novel to indicate sequence of choices.
Underline object names to indicate which objects are recalled.

W = worm	A = army truck	D = dinosaur	C = Candle
M = Mickey Mouse	B = ball	Y = yellow pipe	PT = PT boat
R = reflector	F = flashlight	G = Giraff	Br = Brush
P = puzzle	Wr = wrench	Cr = Crutch tip	Cb = comb
J = jumping jack	T = telescope	H = handle	S = screwdriver

Time	Description of behavior

Experiment I, Day 2

Instructions for Novelty Sort

"There is something I am trying to find out about the way children think about things like we have here. I would like to know which of these objects seem novel or unusual to you. Which ones do you not often see or seem like they are unusual in some way? Put over here the ten (10) that seem most unusual to you. You can leave the rest of them where they are."

(While the child is selecting the novel objects, indicate which are selected in the order they are selected by writing consecutive numbers in front of the object names on the recording sheet.

After the sort, place the objects in a box and store them in the cabinet.)

Schedule # 1c

Subject _____ Observer _____

Experiment II, Day 1
Complexity Series

Date _____

Tachistoscopic Exposure Frequencies
Curiosity Study

	COMPLEXITY LEVEL		ABSTRACT LEVEL	
	I	II	I	II
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
Totals				

Schedule # 2c

Subject _____ Observer _____

Experiment II, Day 1
Complexity Series

Date _____

Tachistoscopic Exposure Frequencies
Curiosity Study

	COMPLEXITY LEVEL		ABSTRACT LEVEL	
	I	II	I	II
2				
10				
12				
14				
17				
8				
19				
5				
4				
7				
20				
9				
21				
11				
18				
6				
1				
13				
16				
23				
3				
24				
22				
15				
Totals				

Schedule # 11

Subject _____ Observer _____

Experiment II, Day 2
Incongruity Series

Date _____

Tachistoscopic Exposure Frequencies
Curiosity Study

	Incongruity Level		Ambiguity Level	
	I	II	I	II
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
Totals				

Schedule # 21

Experiment II, Day 2
Incongruity Series

Subject _____ Observer _____

Date _____

Tachistoscopic Exposure Frequencies
Curiosity Study

	INCONGRUITY LEVEL		AMBIGUITY LEVEL	
	I	II	I	II
5				
22				
3				
19				
21				
18				
23				
14				
12				
13				
9				
15				
2				
17				
8				
10				
4				
20				
11				
16				
6				
1				
24				
7				
Total				

Experiment II, Day 2

Instructions for Immediate Recall

"Now I would like to find out how many of the objects that we just put away that you can remember. Just name or describe as many as you can. Go ahead."

(Indicate which objects are recalled by underlining the name of the object on the recording sheet. After this is completed, proceed with presentation of the tachistoscopic slides.)

Experiment III, Day 3

Name _____

Delayed Recall

Date _____

List below all the things you can remember of those that were on the table the second day you went into the Mobile Laboratory.

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.
18.
19.
20.

VERBAL CREATIVE THINKING TASKS

FORM VA

Name: _____ Date: _____

Grade: ____ Teacher: _____ School: _____

INTRODUCTION: These tasks are a test of your ability to use your imagination, to think of new ideas. There are no "right" answers in the usual sense. We want you to think of as many ideas as you can. Try to think of unusual, interesting, and clever ideas--something which no one else in the class will think of.

You will be given three tasks to do and you will be timed on each one, so do not waste time. Work as rapidly as you can with comfort. If you run out of ideas before time is called, wait until instructions are given before going on to the next task.

****

PART 1. ASK AND GUESS. These three tasks will be based on a picture which will be shown to you in a moment. In the spaces below write down all of the questions you can think of about the things you see in the picture. Ask the questions you would need to know to understand what is happening. Do not ask questions which can be answered just by looking at the picture.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
0. _____
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
0. _____
1. _____
2. _____
3. _____
4. _____
5. _____

'ART 2. GUESS CAUSES. In the spaces below, list as many possible things as you can which might have caused the action shown in the picture. You ay use things that might have happened just before the event in the pic- ure, or something that happened a long time ago that had an influence on he present event. Make as many guesses as you can. Don't be afraid to uess.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
0. _____
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
0. _____
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

PART 3. GUESS CONSEQUENCES. In the spaces below, list as many possibilities as you can of what might happen as a result of what is happening in the picture. You may use things that might happen right afterwards or things that might happen as a result long afterwards in the future. Make as many guesses as you can. Don't be afraid to guess.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____
17. _____
18. _____
19. _____
20. _____
21. _____
22. _____
23. _____
24. _____
25. _____
26. _____
27. _____

Appendix B

Code numbers for scores used in factor analyses

Correlation matrix

Factor matrix for 20 factor solution

Table 13

Code Numbers for Scores Used in Factor Analyses

Code Number	Type of score
	Tachistoscopic exposure frequencies
1	Low complexity, low abstractness
2	Low complexity, high abstractness
3	High complexity, low abstractness
4	High complexity, high abstractness
5	Low incongruity, low ambiguity
6	Low incongruity, high ambiguity
7	High incongruity, low ambiguity
8	High incongruity, high ambiguity
	Exploratory times with curiosity objects
9	Novel object
10	Mirror
11	Kaleidoscope
12	Wire puzzles
13	Jig-saw puzzle
14	Book
	Intensity ratings with curiosity objects
15	Novel object
16	Mirror
17	Kaleidoscope
18	Wire puzzles
19	Jig-saw puzzle
20	Book
	Exploratory times with novel and not-novel objects
21	Novel objects
22	Not-novel objects
	Intensity ratings with novel and not-novel objects
23	Novel objects
24	Not-novel objects

Table 13 (Con't)

Code Number	Type of score
	Creativity scores (Ask-and-Guess Test)
25	Ask fluency
26	Ask flexibility
27	Ask adequacy
28	Guess fluency
29	Guess flexibility
30	Guess adequacy
31	Consequences fluency
32	Consequences flexibility
33	Consequences adequacy
	Number of objects recalled
34	Immediate recall, novel objects
35	Immediate recall, not-novel objects
36	Delayed recall, novel objects
37	Delayed recall, not-novel objects

Table 14

Correlation Matrix for 37 Variables

	1*	2	3	4	5	6	7	8	9	10
2	.96									
3	.92	.86								
4	.95	.94	.94							
5	.90	.87	.94	.90						
6	.92	.90	.89	.91	.96					
7	.91	.88	.91	.90	.95	.94				
8	.93	.90	.94	.92	.96	.96	.95			
9	.03	.10	-.04	.00	.03	.04	.07	.03		
10	-.03	-.05	-.07	-.10	-.04	-.09	-.04	-.07	-.15	
11	.15	.16	.09	.08	.15	.13	.23	.13	.31	-.04
12	.11	.15	.06	.21	.00	.08	.05	.09	.16	-.22
13	-.01	-.05	.04	.01	.01	.01	-.06	.00	-.34	-.37
14	-.10	-.05	-.05	-.04	-.02	-.04	.03	-.05	.29	-.11
15	.09	.14	.01	.05	.09	.07	.13	.04	.66	-.03
16	.08	.05	-.04	-.05	-.01	-.07	-.03	-.01	.08	.58
17	.26	.32	.08	.16	.24	.30	.30	.25	.46	-.09
18	-.04	-.04	-.06	.00	-.1	-.05	-.05	-.08	.13	-.26
19	-.10	-.10	-.19	-.13	-.21	-.18	-.22	-.21	.00	-.30
20	-.23	-.21	-.16	-.18	-.20	-.21	-.16	-.23	.18	-.18
21	.31	.29	.30	.31	.21	.23	.20	.24	-.09	.00
22	-.11	-.07	-.13	-.08	-.02	-.02	.02	-.04	.17	-.20
23	.22	.25	.21	.26	.20	.21	.18	.20	.18	-.17
24	.08	.10	.06	.03	.11	.10	.13	.12	.05	-.24
25	-.07	-.07	-.15	-.12	-.13	-.14	-.19	-.14	.10	.13
26	-.04	-.04	-.13	-.10	-.09	-.10	-.15	-.09	.12	.17
27	-.07	-.07	-.15	-.12	-.13	-.14	-.20	-.13	.05	.13
28	-.13	-.08	-.16	-.10	-.16	-.11	-.22	-.14	.14	-.09
29	.00	.05	-.11	-.02	-.10	-.06	-.12	-.08	.21	-.13
30	-.32	-.29	-.21	-.24	-.29	-.33	-.33	-.32	-.10	-.02
31	.08	.04	.04	.04	.04	.05	.00	.03	-.06	.23
32	.12	.10	.00	.05	.05	.11	.04	.07	.14	.17
33	-.13	-.14	-.10	-.09	-.13	-.14	-.19	-.15	-.04	.01
34	.05	.05	-.02	.06	-.06	-.05	-.04	-.07	-.01	.02
35	-.25	-.21	-.24	-.16	-.21	-.14	-.18	-.25	-.05	-.08
36	-.01	-.01	-.04	-.01	-.08	-.12	-.12	-.15	-.12	-.01
37	.26	.28	.08	.13	.09	.02	.05	.06	.13	.16

Table 14 (Con't)

	11	12	13	14	15	16	17	18	19	20
12	-.04									
13	-.46	-.33								
14	.24	.02	-.39							
15	.25	-.03	-.19	.28						
16	.09	-.20	-.33	-.03	.14					
17	.69	-.01	-.33	.21	.35	.21				
18	-.02	.63	-.16	.10	-.10	-.29	.08			
19	-.20	-.09	.60	-.18	.02	-.07	-.01	.14		
20	.17	.08	-.24	.53	.21	-.12	.05	.24	.05	
21	-.02	.30	-.03	.03	-.06	-.02	.02	.30	.05	.06
22	.17	-.04	.15	.05	.14	-.18	.16	-.08	.12	-.06
23	.06	.22	.03	.10	.14	-.14	.12	.15	.15	.11
24	.18	.03	.08	.05	.07	-.08	.14	.04	.08	.12
25	.05	.08	-.13	-.08	.11	.20	-.01	.00	-.09	-.14
26	.10	.04	-.18	-.18	.12	.19	.03	-.08	-.17	-.19
27	.05	.10	-.14	-.08	.03	.21	.00	.04	-.09	-.16
28	-.10	.28	-.10	.06	.00	-.02	.01	.19	-.22	-.06
29	-.05	.15	.02	-.04	.15	-.02	.02	.08	.03	-.04
30	-.23	.08	-.08	.24	-.13	.02	-.26	.19	-.10	.26
31	.13	.05	-.15	-.02	.00	.14	.07	.00	-.07	-.09
32	.20	.03	-.16	-.05	.10	.12	.26	-.08	-.08	-.06
33	-.02	.03	-.08	.16	-.01	.09	-.07	-.04	-.10	.09
34	.09	.16	-.07	-.04	-.01	.10	.06	.01	.12	.24
35	-.18	.05	-.03	.14	-.08	-.07	-.06	.18	-.05	.22
36	-.09	.10	.11	-.06	.16	.11	.00	.02	.13	.26
37	.05	.00	-.07	.01	.36	.52	.18	-.11	.17	-.08

	21	22	23	24	25	26	27	28	29	30
22	-.57									
23	.55	.02								
24	-.02	.40	.34							
25	.08	-.09	-.06	-.06						
26	.05	-.15	-.09	-.10	.95					
27	.10	-.15	-.10	-.08	.98	.94				
28	.02	.03	-.13	-.09	.65	.57	.64			
29	.00	-.10	-.12	-.16	.62	.59	.59	.61		
30	.00	-.07	-.03	.09	.03	-.05	.01	.34	-.10	
31	.04	-.15	-.09	-.29	.60	.55	.60	.43	.41	-.02
32	-.06	-.08	-.17	-.32	.49	.52	.49	.37	.31	-.26
33	-.04	-.07	.00	-.12	.44	.34	.42	.41	.13	.46
34	.22	-.16	.26	.01	.14	.12	.13	.05	.03	.06
35	-.22	.18	-.23	-.20	-.16	-.20	-.17	.15	.03	.28
36	.33	-.25	.26	-.13	.09	.06	.07	.02	.06	.16
37	.12	-.08	.07	.05	.22	.16	.22	.10	.25	.03

Table 14 (Con't)

	31	32	33	34	35	36	37
32	.77						
33	.56	.26					
34	.23	.17	.21				
35	-.13	-.13	.08	-.02			
36	.04	-.06	.20	.42	.13		
37	.08	.01	.05	-.04	-.04	.33	

Table 15

Factor Matrix for 10-factor Solution

Score	Factor I	II	III	IV	V	VI	VII	VIII	IX	X
1	.96	.02	.00	.06	.14	-.02	-.10	.05	.01	.03
2	.94	.02	.07	.03	.16	-.02	-.08	.03	.03	.08
3	.95	-.07	-.05	.13	-.04	.00	.04	-.03	.02	-.05
4	.97	-.03	-.02	.08	.02	-.04	.02	.03	-.01	.10
5	.97	-.04	.02	.00	-.02	.04	-.02	-.03	.04	-.10
6	.97	-.04	.02	-.04	-.07	.01	-.07	.00	-.01	.02
7	.95	-.12	.07	-.04	-.04	.10	-.08	.00	.03	-.03
8	.98	-.03	-.02	.00	-.04	.05	-.08	-.05	.05	-.02
9	.02	.11	.77	-.12	.07	.12	-.17	-.08	.06	.17
10	-.08	.06	-.28	.16	.44	.53	-.10	.00	-.18	-.31
11	.13	.04	.40	-.22	-.07	.46	-.30	.39	.22	-.04
12	.10	.11	-.01	.11	-.04	.11	.04	.04	.05	.85
13	.01	-.08	-.27	-.05	-.12	-.87	-.02	-.07	.04	-.22
14	-.04	-.12	.61	.05	-.20	.32	.42	.02	.00	-.03
15	.07	.08	.80	-.01	.26	-.04	-.06	-.04	.04	-.12
16	-.03	.11	-.02	.02	.77	.35	-.05	.10	-.05	-.25
17	.23	.02	.49	-.30	.15	.26	-.33	.36	.10	.12
18	-.07	-.02	.05	.10	-.16	.02	.04	.03	.01	.84
19	-.19	-.12	.06	.00	.11	-.73	-.23	.22	.08	.05
20	-.22	-.23	.51	.17	-.21	.08	.37	.32	-.03	.09
21	.25	.04	-.02	.77	.04	-.03	-.01	.15	.17	.30
22	-.04	-.09	.11	-.80	-.07	-.14	-.01	-.01	.33	.00
23	.21	-.08	.18	.39	-.02	-.16	.00	.26	.56	.18
24	.08	-.10	.06	-.22	-.01	-.05	.06	-.01	.84	.04
25	-.10	.95	.01	.06	.11	.03	.04	.01	.08	-.01
26	-.08	.92	.00	.08	.09	.09	-.09	-.03	.04	-.06
27	-.11	.94	-.03	.08	.11	.06	.00	.00	.06	.02
28	-.09	.73	.03	-.15	-.02	.01	.34	-.11	-.07	.31
29	-.03	.71	.24	-.01	.04	-.25	-.06	-.13	-.26	.19
30	-.27	.00	-.09	.03	.06	.09	.80	-.02	.12	.12
31	.08	.71	-.09	.00	-.09	.12	.02	.40	-.27	-.10
32	.10	.64	.10	-.10	-.13	.11	-.26	.32	-.40	-.08
33	-.09	.48	-.05	-.04	-.05	.06	.58	.34	-.02	-.14
34	-.02	.10	-.06	.19	.06	-.05	.07	.75	.06	.09
35	-.18	-.22	.01	-.37	.10	-.06	.44	.03	-.44	.30
36	-.06	.00	.08	.37	.38	-.30	.27	.47	-.08	.08
37	.13	.17	.24	.04	.81	-.14	.07	-.03	.05	.00